

CURRENCY RECOGNITION AND CONVERTER SYSTEM

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This thesis is submitted as partial fulfillment of the requirements for the award of the
Bachelor of Electrical Engineering (Hons.) (Electronics)

Faculty of Electrical & Electronics Engineering
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OCTOBER, 2008

ACKNOWLEDGEMENT

Assalamualaikum w.b.t.. In the name of Allah, the Most Gracious, the Ever Merciful. Praise is to Allah, ord of the Universe and Peace and Prayers be upon His Final Prophet and Messenger Muhammad s.a.w.

I am greatly indebted to my supervisor, Mr. Reza Ezuan Bin Samin for his advice, ideas, guidance throughout my project. Thanks a lot to him.

I also would like to express my gratitude to my parents and all my family for the moral support and motivation from the beginning until now. Without them I would never come this far. Thank you very much.

Special thanks to FKEE staffs for helping me to complete my project. Suggestion and criticisms from my friends have always been helpful in finding solutions to my problems. Thank you all.

Finally, I would like to express my thanks to those who involves directly or indirectly in completion of my project.

ABSTRACT

The ease with which we recognize a face, understand spoken words, read handwritten characters, identify our car keys in our pocket by feel, and decide whether an apple is ripe by its smell belies the astoundingly complex processes that underlie these acts of pattern recognition. As for currency recognition and converter system is an image processing technology that is used to identify currency amount and convert it into the other currencies as the users need. The purpose of currency recognition and converters is accurately to recognize the currencies and convert the currency immediately into the other currency. It can help human in order to live a better life. The system based on the computer communicates with web cam, catches video frames which include a visible image of currency amount and processes them. Various methodologies are used on the surface of the image. The selected area of the image is processed and analyzed with their parameters. Once the image of the currency amount was detected, its digit is recognized it will display on the user interface. This program will be developed using MATLAB. MATLAB is a high – performance language for technical computing.

ABSTRAK

Dalam menjalani kehidupan seharian, kita sangat mudah untuk mengenal wajah manusia, memahami segala perbualan sesama kita, mengenali tulisan yang tertera, mengenal kunci kereta, sehinggalah boleh mengetahui sama ada buah itu masak atau tidak. Ini semua adalah salah satu proses mengenali corak atau rentak suasana yang di sekeliling kita. Begitu juga dengan sistem mengenali matawang dan menukarkannya ke matawang asing yang merupakan salah satu aplikasi pemprosesan imej yang dibina untuk mengenal nilai matawang serta menukarkannya kepada matawang asing. Kegunaan program ini adalah untuk memudahkan kerja – kerja manusia dalam proses pengecaman nilai matawang serta menukarkannya kepada matawang lain dengan lebih efektif. Ini boleh membantu manusia untuk menjalankan kerja – kerja seharian dengan lebih cepat dan lancar. Sistem ini memproses imej duit yang diterima daripada kamera dan mengekstrak data pada imej tersebut. Seterusnya, imej ini akan terus diproses dan dibezakan antara satu sama lain melalui parameter yang telah didapati bagi setiap imej. Apabila imej itu telah dikenalpasti, nilai matawang tersebut akan dipaparkan pada skrin pengantara dengan pengguna (GUI) dan seterusnya pengguna boleh menukarkan nilai wang tersebut kepada matawang asing. Pengguna boleh memilih matawang asing mengikut senarai matawang yang tertera pada GUI tersebut. Program ini dihasilkan menggunakan perisian MATLAB.

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CHAPTER 1

INTRODUCTION

1.1 Background

This chapter explains the background of implementation between hardware, image processing, and neural network, for each part of the currency recognition system.

This thesis presents currency recognition as an application of computer vision. Computer vision is a process of using a computer to extract high level information from a digital image.

1.2 Image Processing

Image processing is any form of signal processing for which the input is an image, such as photographs or frames of video. The output of image processing can be either an image or a set of characteristics or parameters related to the image. Most image processing techniques involve treating the image as a two-dimensional signal and applying standard signal-processing techniques to it.

Image processing usually refers to digital image processing, but optical and analog image processing are also possible.

1.3 Artificial Neural Network System

An artificial neural network (ANN), also called a simulated neural network (SNN) or commonly just neural network (NN) is an interconnected group of artificial neurons that uses a mathematical or computational model for information processing based on a connectionist approach to computation. In most cases an ANN is an adaptive system that changes its structure based on external or internal information that flows through the network.

1.4 Problem Statement

Currency Recognition and converter system is implemented to reduce human power to automatically recognize the amount of currency and convert it into the other currency without human supervision. Previously, human is needed to recognize the amount of the currency and convert it manually. So this project is developed to replace human power to recognize the amount of the currency.

1.5 Project Objectives

The objectives to develop this system are:

- Develop the program that can determined the amount of paper currency using neural network
- The system able to convert the currency from Ringgit Malaysia into other currencies after the amount have been determined

1.6 Project Scopes

The scope of this project is to develop a currency recognition and converter system by using image processing and neural network. In other to implement this system we have to use MATLAB Toolbox to achieve the objectives of the project. Thus, the focuses of this project are:

- i. To implement the system in order to recognize the currency amount.
- ii. To integrate hardware and software.
- iii. Extract the data from the currency image by using digital image processing toolbox.
- iv. Recognize the image of the currency amount by using neural network technique, using a feed-forward network with 3 layers

1.7 Structure of Proposed System

To achieve all the project objectives, the system must have a few stages. The stages are:

- **Image Acquisition**

The money tested in this project was Ringgit Malaysia 1, 5, 10 and 50. This amount of currency is used because it is easy to get a sample. The image was captured using a PC camera with 1.3 megapixels (Logitech QuickCam E3500 Plus).

- **Data Extraction**

Currency extraction is the key in a currency recognition system, which influences the accuracy of the system significantly. This is a very critical stage.

- **Currency Segmentation**

Currency segmentation takes the region of interest and attempts to divide it into individual characters.

- **Currency recognition**

Currency recognition is the last phase in currency recognition system. This stage will involve neural network system to recognize the isolated characters.

1.8 Thesis Organizations

Chapter 1: Explains the background of the image processing, neural network, objectives of the project and structures of the project.

Chapter 2: Focus on the previous projects contributions to this project. A brief literature review of the techniques used in Currency Recognition System

Chapter 3: Explains and discuss details about image processing process and neural network system. It discusses the brief review of how the morphology works in this project.

Chapter 4: Discuss on experimental analysis and results obtained at different stages under different conditions are discussed.

Chapter 5: Discuss on the conclusion for this project. This chapter also discuss on the problem encounter and recommendation for this project for future development or modification.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will discuss about the previous project that have been done by others. Besides that, it gives basic knowledge about image processing and neural network.

2.2 Neural Network System

Up until now, we have developed banking machine for various kinds of paper currency using neural networks (NNs). In this paper, we report an enhanced neuro – recognition system to increase the more number of recognition patterns using axis – symmetrical mask and two image sensors. One sensor purpose is discrimination for a known image and another one is exclusion for an unknown image. Concretely, we implement the proposed method to an experimental system, which has two sensors. In addition, they are arranged on the up side and down side of the aisle, respectively.

Finally, we apply this proposed method to Euro currency, which will be delivered in 2002 year, using its dummy. The effectiveness of the proposed method is shown, numerically [1].

Nowadays, neural networks (NNs) are widely used in many fields of engineering and the most famous application is pattern recognition. In our previous researches, a banknote recognition system using a NN has been developed for various applications in worldwide banking systems such as banknote readers and sorters. In this paper, a new kind of banknotes, Thai banknotes, are being proposed as the object of recognition. First, the slab values, which are digitized characteristics of banknote by the mask set, are extracted from each banknote image. These slab values are summation of non – masked pixel values of each banknote. Second, slab values are inputted to the NN to execute its learning and recognition process. Third, for commercial usability, the NN algorithm is implemented on the DSP unit in order to execute the continuous learning and recognition. We show the recognition ability of the proposed system and its possibility for self – refreshed function on the DSP unit using Thai banknotes [2].

Standard back – propagation is a gradient descent algorithm. It was created using the Window – Hoof learning rule. The rule is the network weights and biases are updated or generated in the direction of the negative gradient of the performance function. The performance function is measured by MSE (mean square error)---the average squared error between the network outputs and the target outputs. This network can be used to approximate a general function. It can approximate equally well function with a finite number of discontinuous [3].

2.3 Images Representation

A digital image is a representation of a two-dimensional image using ones and zeros (binary). Depending on whether or not the image resolution is fixed, it may be of vector or raster type. Without qualifications, the term "digital image" usually refers to raster images[4].

Raster images can be created by a variety of input devices and techniques, such as digital cameras, scanners, coordinate-measuring machines, seismographic profiling, airborne radar, and more. They can also be synthesized from arbitrary non-image data, such as mathematical functions or three-dimensional geometric models; the latter being a major sub-area of computer graphics. The field of digital image processing is the study of algorithms for their transformation[4].

An image is stored as a matrix using standard MATLAB matrix conversions. There are five types of images supported by MATLAB:

- Intensity images
- RGB images
- Binary images
- Indexed images

2.3.1 Intensity Images

Intensity images are the simplest format for grayscale images. An intensity image is a data matrix, whose values represent intensities within some range[5].

2.3.2 RGB Images

The RGB color model is an additive color model in which red, green, and blue light are added together in various ways to reproduce a broad array of colors. The name of the model comes from the initials of the three additive primary colors, red, green, and blue[6].

RGB is a device-dependent color space: different devices detect or reproduce a given RGB value differently, since the color elements (such as phosphors or dyes) and their response to the individual R, G, and B levels vary from manufacturer to manufacturer, or even in the same device over time. Thus an RGB value does not define the same *color* across devices without some kind of color management[6].

The main purpose of the RGB color model is for the sensing, representation, and display of images in electronic systems, such as televisions and computers, though it has also been used in conventional photography. Before the electronic age, the RGB color model already had a solid theory behind it, based in human perception of colors[6].

2.3.3 Binary Images

A binary image is a digital image that has only two possible values for each pixel. Typically the two colors used for a binary image are black and white though any two colors can be used. The color used for the object(s) in the image is the foreground color while the rest of the image is the background color[7].

Binary images are also called bi-level or two-level. (The names *black-and-white*, *B&W*, monochrome or monochromatic are often used for this concept, but may also designate any images that have only one sample per pixel, such as grayscale images.) In Photoshop parlance, a binary image is the same as an image in "Bitmap" mode[7].

Binary images often arise in digital image processing as masks or as the result of certain operations such as segmentation, thresholding, and dithering. Some input/output devices, such as laser printers, fax machines, and bi-level computer displays, can only handle bi-level images[7].

2.3.4 Indexed Images

In computing, indexed color is a technique to manage digital images' colors in a limited fashion, in order to save computer's memory and file storage, while speeding up display refresh and telecom transfers. When an image is encoded this way, the color information is not directly carried by the image pixel data, but it is stored into a separate piece of data called a palette: an array of color elements, in which every element, a color, is indexed by its position within the array. This way, each pixel does not contain the full information to represent its color, but only its index into the palette. This technique is sometimes referred as pseudocolor or indirect color, as colors are addressed indirectly[8].

CHAPTER 3

METHODOLOGY

3.1 Introduction

In this chapter, the process of recognition phase will be discussed. It will cover about software process, analysis, design and development of the project. It also will explain about the software and hardware that will be used in this project. There are two phases in this project which are image processing phase and neural network phase.

3.2 Image Processing Phase

For the image processing program the system required various methodologies to process the desired image. The methodology includes convert the image, crop the region of interest (ROI), dilation method, erosion method, threshold, complement the image and applied some parameters to calculate the value of area boundaries to distinguish each character of number in the image.

3.2.1 Image Acquisition

The money tested in this project was Ringgit Malaysia 1, 5, 10 and 50. This amount of currency is used because it is easy to get a sample. The image was captured using a webcam with 1.3 megapixels (Logitech QuickCam E3500 Plus). The images were taken under natural daylight or with lighting from pendaflour lamp.

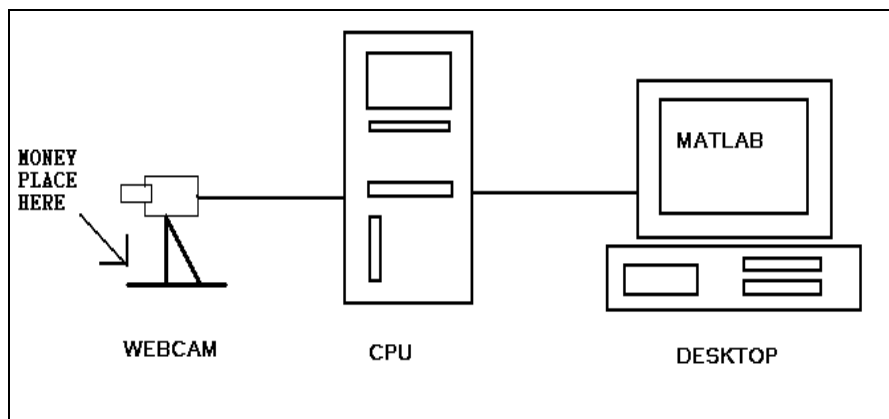


Figure 3.1: Image Acquisition Setup



Figure 3.2: Currency Recognition and Converter system Model

3.2.2 Captured Images

As the first step in the flow chart, the image of the money was captured by using webcam.

3.2.3 Developed Data Extraction Program

The extraction program is build by using MATLAB. The function and algorithms must be working sequence to get correct flow and results for the data extraction using image processing toolbox in MATLAB. This stage includes many steps and it is a key step in currency recognition system, which influences the accuracy of the system significantly. This is very critical stages and need a long time to go through.

3.3 Neural Network Phase

The second part is by using the fed forward Neural Network that consists of three layers that are input layers, hidden layers and output layers. The inputs are fed into the input layer and get multiplied by interconnection weights as they are passed from the input layer to the first hidden layer. Within the first hidden layer, they get summed then processed by a nonlinear function (usually the hyperbolic tangent). As the processed data leaves the first hidden layer, again it gets multiplied by interconnection weights, then summed and processed by the second hidden layer. Finally the data is multiplied by interconnection weights then processed one last time within the output layer to produce the neural network output.

3.4 Development of Converter System

The value of each currency is different from each other according to their parameters of boundaries and areas. This is easy to distinguish them from each other. The Ringgit Malaysia will convert into US Dollar, Baht and Rupiah.

The conversion rates are always changing time by time. The weakness for this project is the rates of the converter have to be updated daily by manually. For further improvement, this project has to implement with web base so that the rates of the conversion system are up to date.

3.5 Display The Amount Of The Currency

The recognition amount of the currency and the converted amount are displayed on the Graphical User Interface (GUI). GUI is type of user interface which allows people to interact with the software or device. This will helps users to easily used this program. It also provided user friendly environment.

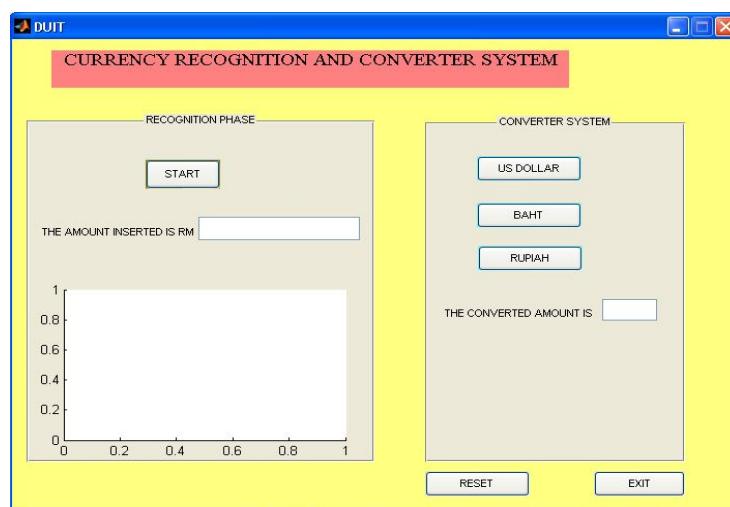


Figure 3.3: Design of Graphical User Interfaced